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The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference MBZ-0345

2. Patent application number *(The Patent Office will fill in this part)* 20 JUL 1998 **9815685.4**

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

MBT Holding AG
Vulkanstrasse 110
CH-8048 Zürich
Switzerland

Patents ADP number *(if you know it)* 7171101001

If the applicant is a corporate body, give the country/state of its incorporation: Switzerland

4. Title of the invention: Waterproofer

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Mr. P. Brown
FEB MBT
Albany House
Swinton Hall Road
Swinton
MANCHESTER M27 4DT

Patents ADP number *(if you know it)* 7178510001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

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Number of earlier application	Date of filing *(day / month / year)*

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Mr. P. Brown
(0161) 794 7411

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MBZ-0345

DUPLICATE

WATERPROOFER

This invention relates to the cladding of partially-overhanging substrates.

By "partially-overhanging substrates" is meant simply a substrate part of which overhangs. One example is a tunnel bored in rock, which has an overhanging roof and non-overhanging walls, but the substrate can equally well be a construction, for example, an arch of concrete, brick, stone or other material.

The exposed rock surfaces of tunnels often require cladding, this cladding generally being concrete, which may be sprayed (so-called "shotcrete"), cast in formwork or placed in prefabricated sections which are then grouted. One of the problems frequently encountered is water coming through and running down the substrate during the construction. The standard way of dealing with this problem is the application to the substrate of a drainage means. This is simply something which provides on the substrate a plurality of drainage channels, so that the water is directed away from the substrate to provided drainage outlets. The sequence therefore is usually as follows; apply a drainage means, followed by a waterproof membrane, followed by a final layer of concrete.

The drainage means known to the art can take various physical forms. One popular type comprises an open mesh made of plastics material, this being generally supplemented by an at least partially waterproof covering sheet to help direct the water to the provided drainage outlets and prevent it, in the case of high water flow, from running straight through. Another common type is a sheet of plastics material (typically of PVC or PE) which provides drainage channels. In one such material, the sheet comprises grooves through which water can run. In another variant, there is formed on the sheet a series of depressions which appear as protrusions on the other side of the sheet . These protrusions hold the sheet off the substrate and allow water drainage. Such drainage means are fixed to the substrate by any convenient means (adhesive, nails, rock anchors).

T this drainage means is usually attached a waterproof membrane. This is generally a series of overlapping sheets of thermoplastic material which is applied to the drainage

means and secured in place by melting the sheet around bolts previously applied through the drainage means into the rock for this purpose, the sheets then being joined by welding to form a single waterproof sheet. A final layer of concrete is applied to them by any of the methods hereinabove described.

In practice, this method suffers from a variety of drawbacks. It is difficult to weld the thermoplastic sheets together with complete success, so that there can be imperfect joins where water can come through. Moreover, such sheets may be damaged in handling and application and consequently suffer from leaks. In any case, the work of applying such sheets is time-consuming and difficult in a tunnel, as is the work of erecting the drainage means itself. In all cases, where other fixtures such as railway catenary supports are required, either these have to be driven through the drainage means into the rock (thereby providing a potential point of water entry), or the final concrete layer must itself be strong enough to support them, which usually means using a thickness of concrete not otherwise required.

It has now been found that such water problems can be substantially or even completely overcome by a particular structure. This invention therefore provides a cladding on a partially-overhanging substrate which comprises, in sequence starting from the substrate;

(i) a drainage means;
(iii) a waterproofing membrane which has been applied thereto by spraying; and
(iv) a layer of concrete.

The invention further provides a method of providing a waterproof cladding on a partially-overhanging substrate, comprising the application to the substrate of the following elements in sequence;

(i) a drainage means;
(iii) a waterproofing membrane, applied by spraying; and
(iv) a layer of concrete.

In a preferred embodiment of the invention, the substrate is given an initial coating of concrete. This is especially important when the substrate is rough, for example, as a result of blasting, and it preferably applied by means of spraying. Although it can also be done by casting or placing of prefabricated sections, shotcreting has the advantage that it conforms more exactly to the wall while providing a desirable smoother surface for the fixing of drainage means. This makes the final cladding essentially a single unit with the wall, enhancing its strength and making possible a cladding with substantially less material than formerly used.

The drainage means may be selected from any of the means of this type known to the art. A typical example is a plastics mesh to which is applied (to that side remote from the substrate) an at least partially waterproof layer. A particularly good variety of this type is a mesh to which is fixed a thin plastics impermeable sheet, on the other side of which sheet is a fibrous layer which assists in the bonding of the waterproofing membrane hereinunder described. However, there are many other types possible, and any of the art-recognised types are acceptable.

The waterproofing membrane must be one that is applicable by spraying. A preferred material is described in International Application WO 97/25484, and a more preferred material is described in International Application WO 98/24738, the contents of which documents are incorporated herein by reference.

Sprayable membranes confer good waterproofness, but cannot be used on a substrate on which there is running water. The combination of drainage means and waterproofing membranes overcomes this difficulty and gives an especially versatile and high-performing system. This is largely because the two components, drainage means and sprayable membrane, become in effect a single composite entity. The invention therefore also provides a composite waterproofing system for application to surfaces, consisting of a drainage means as hereinabove defined and a sprayed waterproof membrane. In addition, fixtures can be added before the membrane spraying and the subsequent membrane spraying will ensure that the penetration of the fixture through the drainage

means remains watertight. This means that a subsequent layer of concrete need not be load-bearing and therefore can be much thinner than would otherwise be the case.

To the surface of the membrane is applied a layer of concrete. This can be done by any convenient means, but ideally by spraying. Spraying brings many advantages. For example, the layer conforms with the membrane and forms with it, the drainage means, the substrate and, if applied, any initial concrete layer a single composite entity, thus enhancing the benefits of the composite waterproofing system hereinabove described. This is very strong and reduces substantially the quantities of concrete needed. For example, using prior art-recognised methods, a final concrete layer would need to be typically 25cm. thick. When this invention is used, a layer may be as low as 5cm. thick, representing a significant saving in time, money and material. In addition, application methods such as casting require not only complex formwork, but also reinforcing grids. The sprayed concrete does not need this, it being possible, if desired, to provide fibre reinforcement in the concrete mix itself by the inclusion of fibres.

The invention is useful primarily in tunnelling, but it may also be used in free-standing completely artificial structures which comprise partial overhangs of the type hereinabove described, for example, arches of concrete, brick, stone or other such material. In comparison with the art-recognised methods, it is simpler to use, it provides better results and it requires less material and time.

The invention will now be described with reference to the accompanying drawing which depicts a schematic cross-sectional view of a preferred embodiment. In this drawing, the dimensions of some elements have been exaggerated to make clear the nature of the construction.

In the drawing, the invention has been applied to a rock wall 1 of a bored tunnel. To this rock wall is applied an initial layer of shotcrete 2. To this is then applied a drainage means, generally designated as 3. This drainage means consists of three elements, a plastics grid 4, a waterproof film 5 and a fibrous coat 6, the three being combined in a single sheet and secured to the shotcrete layer 2 by means of nails 7 whose heads

protrude slightly from the drainage means. The plastics grid 4 has the form of two groups of straight, elongate, parallel elements intersecting each other to form parallelogram-shaped apertures and joined such that one set is nearer to the surface of the layer 2 than is the other, thus defining drainage channels. The film 5 is conveniently made of the same material and is completely waterproof. The fibrous material 6 and the nail heads help the subsequent sprayed membrane 8 to bond more securely to the drainage means.

To the drainage means is applied by spraying a waterproofing membrane 8, this corresponding to Example 1 of WO98/24738. Finally, a layer of reinforcing fibre-containing shotcrete 9 is applied.

The shotcrete formulation useful in this application may be any such formulation useful in such an application. In addition, the skilled person will readily appreciate that there are possible many variations in both materials and methods which fall within the scope of the invention. For example, should enhanced load-bearing strength be needed, the nails 7, depicted in the drawing as being covered by the sprayed membrane 8, may protrude through it and into the shotcrete layer 9. The nail heads provide a "key" which supplements the excellent bonding of the shotcrete to the membrane.

CLAIMS

1. A cladding on a partially-overhanging substrate which comprises, in sequence starting from the substrate;

(i) a drainage means;
(iii) a waterproofing membrane which has been applied thereto by spraying; and
(iv) a layer of concrete.

2. A method of providing a waterproof cladding on a partially-overhanging substrate, comprising the application to the substrate of the following elements in sequence;

(i) a drainage means;
(iii) a waterproofing membrane, applied by spraying; and
(iv) a layer of concrete.

3. A composite waterproofing system for application to surfaces, consisting of a drainage means and a sprayed waterproof membrane.

MBZ-0345

ABSTRACT

A cladding for a partially-overhanging substrate, such as a tunnel wall which comprises, in sequence from the tunnel wall, a drainage means, a sprayed polymeric membrane and a final layer of concrete. The cladding gives an effective cladding in conditions where the tunnel walls suffer from running water at the time of cladding, is easier to apply and requires less material.

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